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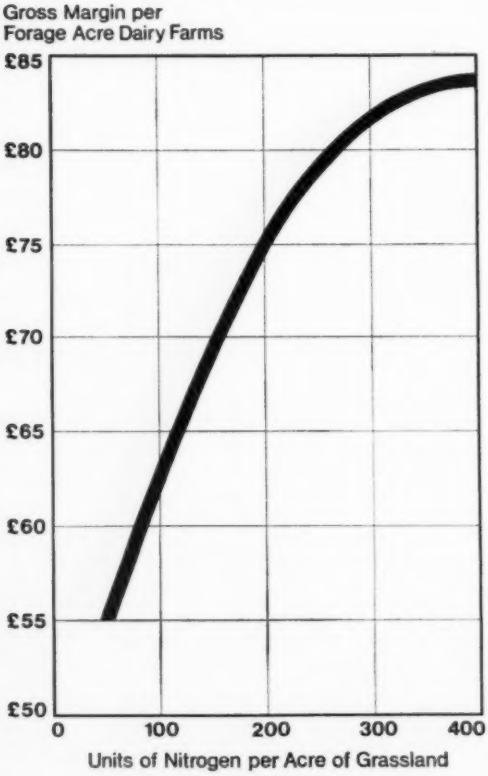

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Agriculture

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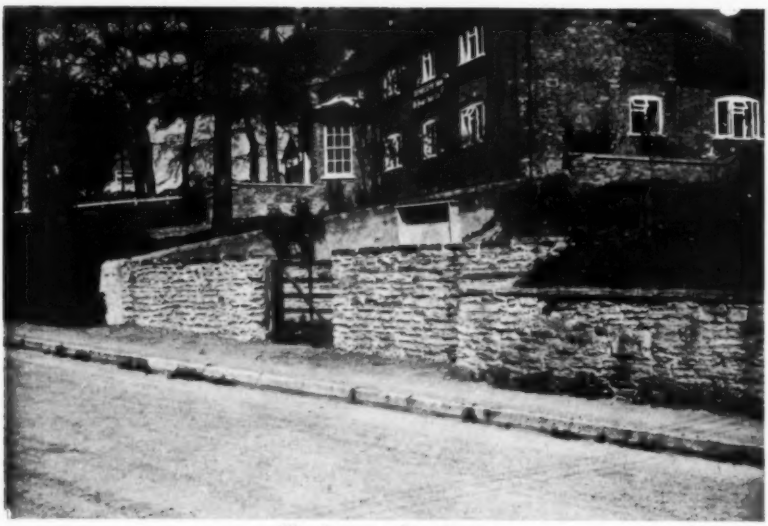


The Dovecote Inn, Laxton

The Laxton Open Fields Estate

J. F. Hoare

TWENTY years ago, in February 1952, there came into the ownership of the Ministry the Laxton Open Fields Estate in North Nottinghamshire. It then comprised about 1,850 acres with twenty-one farms varying in size from 41 acres to 145 acres, a smallholding of 10 acres, eight houses and cottages, three old almshouses, and the Dovecote Inn—a free house. There also passed with the purchase the Lordship of the Manor of Laxton, a title now held by the Minister, together with an active Court Leet and a number of customs, as well as certain Common Rights and Gait Rights.

History

The history of the Manor of Laxton has always provided historians and others with a wealth of interest for it has been possible for the descent of the Manor to be traced back to pre-Conquest days. It is known that at the time of the Conquest it was held by Tochi and during the next 900 years the Manor was in the hands of some thirteen owners, including Robert de Caux,

who built a Norman castle there and who held the title of the Hereditary Keeper of the Royal Forests. Nothing now remains of the castle except the very extensive earthworks which provide one of the finest examples there is of the old Motte with its Baileys. It is recorded that King John stayed at Laxton on at least four occasions, between 1205 and 1213, and later that century, in 1290, Queen Eleanor, the wife of Edward I, also stayed at the castle a few days before she died at Harby in Lincolnshire some twelve miles away. During the 13th and 14th centuries it passed into the ownership of the Lexington and Everingham families, and later still it was purchased by a Sir William Courten who commissioned a complete survey of the Manor in 1625. This survey was carried out by a Mr. Mark Pierce and showed every enclosure and every strip in the Manor (over 3,300 parcels of land in all) with maps and schedules of each of the occupiers, their acreages, their stock and rents. It is a unique record of the layout of the Manor nearly 350 years ago and is to be found in the Bodleian Library in Oxford. Later that same century, the Manor came into the hands of the Earl of Kingston and finally into the Manvers family from whom it was purchased in 1952.

Management

Since the purchase of the property in 1952 about £100,000 has been incurred on capital works and about £50,000 on repairs and maintenance. Three replacement farmhouses have been built and thirteen others re-roofed. Modernization programmes to the fixed equipment have been carried out on nearly all the units, involving the provision of Dutch barns, lean-tos, cattle yards and general purpose buildings to supplement and in some cases to replace largely the old layouts, many of which date from between 1720 and 1780. The benefit of the capital expenditure is partly reflected in the current rent roll, now in excess of £10,000 per annum in contrast to the original rental income of just over £2,000 in 1952.

The last nineteen years have seen many changes in tenancies and instead of the original twenty-one full-time holdings there are now sixteen—five of the original units having been reduced to part-time or retirement holdings each with 7–10 acres of land.

With the exception of the Dovecote Inn and the domestic properties, all holdings are let on normal agricultural tenancies. A typical Laxton holding would contain about 110 acres, 80 acres of normal enclosed land and about 30 acres of land lying in the three Open Fields, with possibly four strips in one of the fields containing, say, 12 acres, three strips in another and five in the third. In general the Open Field land will comprise about one-third of the total area of land included in the tenancy.

The day-to-day management of the Estate differs little from that of any other Ministry property, but there are unique problems associated with the necessity of preserving the Open Field system. For this, there must be sufficient tenants to farm the Open Fields (as part of their tenancies) and to serve on the Jury, a feature which presents certain problems in the determination of any farm structure policy.

One unfortunate characteristic of the Estate is the very wide dispersal of land within the tenancies, resulting in some land lying up to 1½ miles away from the home farm. This is due partly to the fact that all the farmsteads, as with every nucleated village, are very closely grouped in the village, mostly abutting on to the main street, which inevitably leads to a great shortage of

home pastures. Continuous and voluntary exchanges of land, particularly on changes of tenancy, have reduced the fragmentation considerably, but even so many more exchanges are still needed to create adequately sized blocks of land to meet modern farming needs.

Open fields

Originally, and certainly as late as the 17th century, the Open Fields comprised over 1,300 acres which were then farmed in over 2,000 strips. By 1952 the acreage of the three Open Fields had reduced to only 483 acres, farmed in 167 strips. West Field, with 146 acres of arable land, contained 51 strips; South Field of 141 acres was (and is) farmed in 47 strips; and Mill Field, the largest of the three with 196 acres, contains 69 strips. But for the acquisition of the property by the Ministry, it is quite certain that the Open Field system would have disappeared completely by now as a result of further amalgamations of the strips themselves. The Estate was acquired in fact with a primary objective of preserving the remains of the strip system.

Mill Field from the Old Mill site

The Open Fields themselves contain a number of physical features, the main one being the strips themselves which now vary in size from less than an acre to the largest of nearly seven acres, the cropping and grazing of which are governed by the Rules for Grazing and enforced by the Court Leet. Each Open Field also has a network of roads, mostly of stone, which often border the ditches and the strips themselves. In places they lead to or cross areas which are in grass and which are known as sykes, of which there still remain about 85 acres. These sykes formed an essential part of the common grass of the Manor in the Middle Ages and until 1780 many of these grass areas were used for the tethering of different types of stock. After that date, however, it became the practice to sell the grass and for the proceeds to be divided proportionately between each of the gait owners, there being some 312 in all of which the Ministry own 299, the balance being owned by six freeholders and one belonging to the Vicar.

Until 1968 the three Open Fields were farmed on a severely restricted three-course rotation consisting basically of winter corn, spring corn and fallow. Winter corn allows of any winter cereal crop, and possibly winter

beans; spring corn, a spring variety of cereal or mixed corn, seeds or clover ley, whilst the fallow was, as the name implies, uncropped. There was no restriction imposed as to the crop to be grown in the two fields carrying winter or spring corn, but the absence of any fencing to any strip, the dates of entry for necessary cultivation work, the communal rights of grazing which existed over the entire Open Field and the necessity of clearing each Open Field of its individual harvest by a certain date, severely restricted any wider choice of crops.

In January 1968, however, Foot and Mouth disease struck Laxton, which resulted in the slaughter of the last three remaining sheep flocks which were maintained in the Open Fields. At a special meeting of the Court Leet later that year it was enacted that the centuries-old rules should be modified by permitting a fodder crop to be taken from what had been the fallow field, for sheep would never be seen again in the Open Fields and the Court considered that such a change could be made without materially damaging the Open Field System.

The High Street, Laxton

Court Leet and Jury

Until the latter part of the eighteenth century these courts had power to enquire into the more serious offences of treason, arson and felony, for example, and to try cases of drunkenness or assault and other like offences. The basis of the penalties lay in the bye-laws which touched upon the livelihood, the possessions, the farming and every aspect of community life. During the last 200 years, however, with the introduction of the present legal system, and particularly with the impact of the enclosure movements, many Courts Leet ceased to function. That at Laxton, however, continues actively to this day, meeting once a year, exercising proper control of the Open Fields and its customs, and authorizing the payment of fines on those found guilty of breaches of the rules.

The overall responsibility lies with the Steward, who is appointed directly by the Minister, an office currently held by a prominent solicitor from Newark. It is his function to keep the records, to swear in the Foremen and Jury for the coming year and to see that the Court conducts itself according

to the law and custom. The day-to-day responsibility for the supervision of the Open Fields rests mainly with the Bailiff and it is he who is responsible for convening the Court, for collecting essoigns (fines for failure to attend at Court) and for the collection of any fines imposed by the Jury. The present office holder also combines the duties of Bailiff with that of Pinder, whose main responsibility lies in dealing with any stray cattle or sheep.

The future

Laxton is no different from many hundreds of other small village communities in the country in the sociological problems which face it. In 1832 it had a population of 659. Fifty years later this figure had dropped to 483 and at the last census it could count on 293 inhabitants. The original three village inns which existed up to 1890 have been reduced to the single one—the Dovecote—and of the three village shops which existed forty years ago only one remains, whilst some twenty years ago the village school was closed down.

In spite of these features, however, Laxton fortunately retains a very active community life, and as with all villages this is largely centred around the village hall and the church. There is nothing unusual about the agricultural calendar except for the annual meetings of the Jury and the Court Leet and the Tenants' Dinner which takes place around September/October time normally. The Estate was very fortunate this year in that it was attended by the present Minister, Mr. James Prior, M.P., to the delight of the tenants and their wives. It has always been accepted that the future of the Open Field System rests almost entirely with the Ministry's thirty tenants and a few others in Laxton, with their co-operation and goodwill and their tolerance towards the many hundreds of annual visitors. The Ministry's function as landlord is to try and provide conditions whereby this co-operation and goodwill can be enhanced, and with the inherent pride which the Laxton tenants have in being associated with the Open Field System there is always the hope that it will long continue.

J. F. Hoare, M.A., F.R.I.C.S. is a Senior Surveyor with A.D.A.S., Nottingham. He is the Minister's Agent for the Laxton Open Fields Estate.

Worrying of Sheep by Dogs

Dog owners are urged to be extra careful to keep their dogs under proper control in the countryside. A dog on the rampage among sheep is a menace at any time of the year; when ewes have new-born lambs to care for even greater havoc may be caused. Many sheep are killed and injured every year through attacks by dogs. Such needless slaughter of harmless animals can be avoided by dog owners acting responsibly to ensure that their dogs do not run loose in farming areas.

There are severe penalties for allowing a dog to stray and worry livestock. The person in charge of it is liable to prosecution, fines of up to £50, and an action for damages. Furthermore, a court may order the destruction of the dog. In cases of actual attack, a farmer may shoot the dog if there is no obvious person in charge of it and no other way of stopping the attack. No farmer likes to do this, but it may be the only way he can protect his sheep.

Poultry processing wastes before treatment

Intensive production means more waste for disposal. This article gives an account of some steps taken to solve the problems of

Animal Waste in the U.S.A.

Brian Hodgetts

In the United States there is a well established trend towards intensive animal production and it is known that waste from this can be a major source of air, soil and water pollution. Many intensive production units have developed without sufficient land on which to spread the manure. Land spreading is still, of course, generally the cheapest, most efficient and most popular means of disposing of animal manures, but the economic cost of doing this may in some cases be so high as to make the system unattractive.

The expansion of urban and suburban development into former agricultural areas, together with changes in animal production methods, have accentuated health and pollution problems. Public pressures for improved waste management systems are increasing and new systems for the collection, treatment, disposal and use of animal wastes are evolving. It is expected that the number of large livestock units will increase in the future, as will the number of livestock per unit; both factors will increase the probability of environmental pollution and the need for effective waste management. The problems associated with these units are only just being realized and are expected to become much greater in the immediate future.

Pollution problem

The United States produces 1·7 billion tons of animal wastes annually, one-third of which is in liquid form. The resulting pollution problem is concerned with the contamination of lakes, fish kills, nitrate concentration in the soil, odours and dust, rodent and fly infestation, spread of bacteria and viruses capable of infecting man and the depreciation generally of recreational values.

WATER POLLUTION

It is known that the biochemical oxygen demand of organic manure is extremely high. Such wastes entering streams can cause oxygen depletion and result in serious fish kills and long term ecological disturbances. Further, it is known that an excessive concentration of nitrites in ground water used for drinking may be biologically converted to nitrites in the digestive system and cause problems in infants. Nitrites are also toxic to livestock. Animal manure is a source of nitrates and the importance of its contribution should not be overlooked. In addition, there are some pathogenic organisms present in animal waste products that could be injurious to people, animals and poultry.

AIR POLLUTION

Many concentrated livestock production enterprises in the United States have been forced to cease operating because their neighbours found them to be objectionable; law suits have been brought against many operators because of nuisances caused by odours, dust, flies and rodents.

In the absence of adequate aeration, accumulations of animal manure produce strong offensive odours as a result of bacterial action. These odours can be minimized by keeping the manure as dry as possible during collection and storage. Care must be exercised when spreading on the land to reduce odours by carefully choosing the right time and place for spreading. Some farmers use the so called 'plough down method' whereby the liquid manure is injected below the soil surface; this is a very efficient means of reducing odours. As a final resort the use of commercial masking agents for temporary odour control are fairly successful, but expensive.

SOIL POLLUTION

Soil receiving animal wastes may be contaminated with organisms which might affect humans, animals and plants. Nutrients in the waste may create an undesirable imbalance of nutrients required by certain crops and excess organic materials from heavy applications of some animal wastes may be harmful to some crops and soils. Research workers at Rutgers University suggest that sub-surface water pollution will occur on bare land if more than 200 lb of nitrogen is applied per acre. However, this potential problem could be substantially reduced by ensuring that the application of manure is related to the requirements of the crops grown.

Research Work

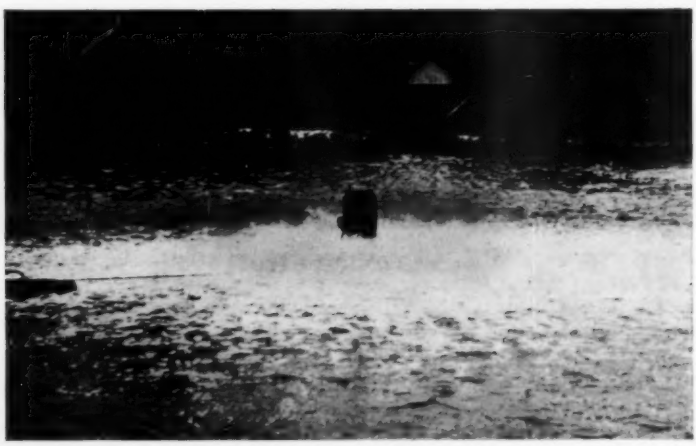
Research aimed at the maintenance of the quality of the environment has only recently been given the necessary impetus to produce meaningful

results. Finance is now being made available by the Federal Authorities. Hitherto, university research has been financed from the universities' own operating funds. The situation has been changing rapidly and waste management is now fast becoming a lucrative field for research. Research in the poultry sector of the livestock industry is typical of the current thinking amongst research and extension groups in the United States. The poultry industry, by virtue of its size and distribution, has made a substantial contribution towards solving the waste management problem.

Handling poultry manure

Poultry manure is generally considered to be a commodity for which there is no further use; its disposal therefore entails a charge which has to be included in the production costs of the enterprise. The manure may or may not receive some form of treatment prior to disposal in order to reduce its potential pollution hazard. These treatments can be classified as aerobic or anaerobic treatment systems.

There is the school of thought which considers poultry manure too valuable a product to throw away; in fact the fields of nutrient re-cycling and the use of fly larvae to produce a food supplement from poultry waste show considerable promise.



Aeration of duck wastes on Long Island

Aerobic and anaerobic treatments

Before considering these treatments individually an explanation of the terminology may be useful. Aerobic treatments involve bacteria which require the presence of free or dissolved oxygen for their metabolic processes. Conversely, anaerobic treatments involve bacteria that do not require the presence of free or dissolved oxygen for their metabolism.

Many of the liquid systems described here (both aerobic and anaerobic) will function better in the summer climatic conditions of the U.S.A. than in cooler temperatures prevailing in Britain. Nevertheless, some successful systems have been installed in Scotland, Holland and Northern Ireland.

AEROBIC LIQUID TREATMENTS

Whilst several universities in the U.S.A. are now researching into aerobic treatment of liquid wastes much of our current knowledge comes from the University of Purdue. Some of the claims made for this system are:

(*a*) odour control;

(*b*) partial decomposition of organic solids into water and odourless gasses such as carbon dioxide;

(*c*) destruction of many pathogenic organisms;

(*d*) reduction in the pollutional characteristics of the wastes, i.e., by lowering the oxygen demand;

(*e*) concentration of the minerals which may be more readily applied to land by some other system.

On Long Island particularly, and in the mid-West and Virginia, duck producers have been driven by pressure from the urban population to develop aerobic waste treatment systems to a high degree of sophistication. The duck producers use a series of relatively shallow lagoons with floating mechanical aerators. A mixture of wash water and solid duck wastes enters the lagoons where sedimentation and aeration occurs. The final effluent is chlorinated and returned to the stream or watercourse. The application of aerobic liquid systems to other classes of livestock is still in its development stages; separate design criteria are required for dairy, pig and poultry wastes. Foaming, sedimentation and high running costs seem to be the main problems associated with these systems.

A refinement of this system is the oxidation ditch, which can be used indoors under battery cages or under slatted floor piggeries; the ditch is not a new development, but its application to livestock wastes is. The ditch is made up of two principal parts—a continuous open channel ditch, often shaped like a race track, and an aeration rotor that supplies the oxygen and circulates the ditch contents. In the United States approximately 300 oxidation ditches are now in operation in livestock buildings. A problem in northern climates with both the oxidation ditch and the floating aerator is that during the winter months ice build up can shut down the motor.

AEROBIC SOLID TREATMENTS

These include the 'Bressler' system and composting.

'*Bressler*' *system.* This is an interesting development of aerobic treatment of solid wastes used at Pennsylvania State University. Here a system of fans and scrapers aerate and turn the manure beneath the cages of a deep pit laying unit in order to reduce the odour problem; the final product contains about 30 per cent moisture. Although the system works very well, the capital costs involved in setting up the equipment may be quite high.

Composting. Successful composting is a product of careful control of temperature, moisture and regular turning. It is a means of stabilizing organic manure and rendering it more amenable to eventual disposal. Poultry manure in its raw state is not readily composted. For rapid decomposition it seems the material to be composted should have a moisture content near 50 per cent and an adequate texture to permit air circulation. Poultry manure has a moisture content often in excess of 75 per cent and is usually composed

of very fine particles. In trials at the University of Guelph (Canada) it has been found that mixing wet poultry manure with dry material such as wood shavings results in a mixture which will readily decompose.

ANAEROBIC TREATMENTS

Lagoons. Most of the successful lagoons in the U.S.A. are confined to southern California where they work admirably in the climate in conjunction with the 'wash out' house. This is a system whereby the manure is flushed daily from the house to the lagoon by a stream of water. Treated effluent from the lagoon is re-circulated through the poultry house to provide water for flushing out more manure.

Nutrient re-cycling

Results of work in this field have been well documented in American literature. It cannot be denied that poultry litter has demonstrated its worth as a protein supplement for ruminants but certain precautions must be followed and its nutritional shortcomings appreciated. Detailed research studies are needed to provide more information on the digestibility of the protein energy of the litter and to settle any questions of disease risk.

Research workers at Michigan State University have set up trials to determine the nutritional value of dehydrated poultry waste (DPW) for growing chicks from 1—28 days of age. They have found that the 4-week mean body weight of leghorn type chicks was not influenced when up to 20 per cent of the diet consisted of DPW and that feed efficiency is inversely related to the level of DPW in the diet when fed to broiler type chicks.

Similar trials were carried out to determine the effects of feeding dried poultry manure to laying hens. The highest egg production resulted from birds receiving 10 per cent DPW in the ration. They again found feed efficiency to be inversely proportional to the quantity of the DPW in the ration. Trials with sheep indicated that DPW and dried dairy wastes at about one-third of the total mixed ration were readily acceptable.

The Food and Drugs Agency in the United States is very concerned about the trend towards re-cycling waste products. In New York State the Agency has issued a blanket order which prohibits certain waste products from finding their way back into poultry feed.

Degrading manure with fly larvae. This is a further means of utilizing a natural living organism to break down manure. At the United States Department of Agriculture Research Station at Beltsville, research workers are using the larvae of the house fly to process raw manure from laying hens to produce a fertilizer, a soil conditioner and a feed supplement.

The house fly larvae was selected for testing because it can develop in organic wastes. Fly eggs are placed in fresh manure and allowed to hatch and develop into larvae. The activities of the young larvae aerate and successfully deodorize the manure in 2-3 days and remove 50 per cent of its moisture. The larvae are allowed to pupate and when dried and ground the pupae may be used as a protein source for the growing chick. The remaining manure may be further dried or pelleted and can be used as a soil conditioner or fertilizer, or even as a feed for catfish. The manure from 100,000 hens is expected to produce between 500 and 1,000 lb of purpae meal daily.

Aeration of dairy wastes

Other poultry wastes

Not all wastes from the poultry industry are a problem. It is well established that wastes from processing lines can be profitably re-used. Feathers are dried and ground into feather meal and the solid waste (viscera, legs, heads etc.) is cooked, dried and ground and sold as poultry by-product meal. Both are used extensively in poultry rations. In some processing stations blood is collected and dried and used either as a source of lysine in turkey rations or as a glue constituent in the plywood industry.

Summary

It is fairly obvious that no simple or separate solution is likely to exist in the future for all the waste management problems. Waste management is a factor which in the past has been given far too little consideration at the planning stage. In the long term, attitudes will have to change to maintain an acceptable environment, one acceptable not only to the animals and to the producer, but to society as a whole.

Waste management is also a social and educational problem: social due to the greater use being made of the countryside by an urban orientated population and to the continual expansion of the urban conurbation into rural areas; educational because the livestock producer must enlighten the general public about the problems of providing adequate waste management and because there is the need to train individuals to conduct the research still necessary into the development of new waste management systems.

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Shelter Belts: some ecological notes

H. J. Hooper, *Lands Arm, A.D.A.S., Winchester*

To the farmer, a shelter belt generally means a form of protection for his livestock and crops in harsh weather conditions, shelter for the homestead or perhaps a means of stopping the blowing of light soils. To the naturalist, a shelter belt provides a source of information on plant and animal life. There is no clash between these interests because whatever farm purpose the shelter belt was designed to serve its ecological interest is assured.

Ecology is the attempt to understand the relationship of plants and animals to their environments—where they live, how they live there and, hopefully, why they live there. An environment is the sum of all external forces or influences (for example, heat) that affect the life of an organism. Ecology can be regarded as being made up of three main self-contained but complementary levels—

the Individual — the Population — the Ecosystem

The individual

The individual and its accompanying environment makes up a single complete ecological system. The ecology of the individual is concerned with the way that a particular plant or animal interacts with its environment.

The Population

Each plant or animal is related to other organisms in two ways. First, genetically to other members of its species; second, ecologically to other plants and animals of its biological community. A large number of individuals of particular groups or species are referred to as populations.

The ecosystem

Individuals and populations do not live alone in nature but in association with at least a few, and usually a great many, other plants and animals. The gathering together of organisms is by no means a haphazard accumulation; on the contrary, they are brought together as a machine-like organization which uses energy and raw materials in its operation. Such a community of plants and animals, together with the environment that controls it, is called an ecosystem. An ecosystem can consist simply of a jar of water containing algae and protozoa on a laboratory shelf; a shelter belt of trees with its flora and fauna; the great Amazonian rain forest—and even the earth itself.

The biological part of the ecosystem would usually contain four or five energy or trophic levels which are based on how far the original energy has come through the community. The first trophic level (T_1) is the green vegetation which captures and stores solar energy by photosynthesis and releases oxygen. T_2 consists of the herbivores, followed by T_3 and T_4, the carnivores.

Some organisms are omnivores which eat both plant material and other animals. T_5 includes the decomposers, fungi, bacteria and other small organisms that use dead plant and animal material as food. The situation of trophic levels is a very complex one. The importance of the decomposers is fairly obvious as without them the dead material would simply accumulate.

A shelter belt of trees would form an ecosystem not unlike that of a woodland. However, the influence of nearby hedgerows, grasslands and arable fields would have a marked influence on the flora and it is quite possible, although this needs investigation, that shelter belts will be found to contain a greater diversity of ground flora than normal woodland habitats.

Kilvrough shelter belt of trees showing open nature and shafts of sunlight, a situation favoured by the hover-fly

Research projects

A few of the factors that have been recorded in the course of two recent research projects relating to shelter belts of trees may be of interest.

Project A. Kilvrough shelter belt. Gower, South Wales. Dominant species—oak. Four other hardwood species and three softwood species are also present in small numbers. There is no shrub layer and the whole of the belt of about 1·2 hectares is grazed at times by cattle.

Project B. Rutherley shelter belt. Bridget's Experimental Husbandry Farm, Martyr Worthy ,Winchester. Dominant species—oak; silver birch with hazel coppice as the dominant shrub layer. About nine other shrub species exist in small numbers. The belt is 20 metres wide and 320 metres long and is fenced, thus preventing entry of stock.

The grazing and walking of cattle in Kilvrough has reduced the ground flora cover. Twenty species of flora were identified. It was noticeable that some of the field and hedgerow type flora have penetrated up to about 30 metres into the belt. At Rutherley the ground flora is abundant and thirty-nine species have been identified; the dominant woodland type species are shown in the table overleaf:

Table

Rutherley shelter belt. Dominant woodland type species

Species	Number per square metre	
	Maximum	Average
Bluebell	52	33
Dog's Mercury	140	58
Wood anemone	188	96

The presence of a shrub layer and an abundance of ground flora appears to have a marked effect upon the leaf litter of the forest floor. A great deal more dead wood and brush lying about produces micro-habitats for the decomposers, fungi, etc.

The ecology of soil animals is a complex study in itself. From the very small to the not so small, or Microfauna (up to 0·16mm), Mesofauna (0·16 to 10·4mm) and Macrofauna (10·4mm and above) includes numerous animals which are classified for ease of reference:

Example	*Insect Seven-Spot Ladybird*	*Spider Species*
Phylum	Arthropoda	Arthropoda
Class	Insecta	Arachnida
Order	Coleoptera	Araneae
Family	Coccinellidae	Clubionidae
Genus	Coccinella	Clubiona
Species	septempunctata	pallidula

Sub-divisions of Class, Order and Family are made in some instances. Insect studies at Kilvrough (related to the hover-fly) and at Bridget's (saw-flies) provide habitat and animal behaviour patterns of interest. Population studies of the small mammal, the long-tailed field mouse, are made by using Longworth mammal traps. They feed as herbivores and are very partial to sunflower seeds used as bait. A typical predator is the shorteared owl.

By setting up a series of small meteorological stations along the periphery of and inside the shelter belt, it is possible to record and study temperature and humidity readings over a period of time. Readings, in the cases of Kilvrough and Bridget's were taken at 50 cm above ground level, at ground level, and 10 cm, 20 cm, 30 cm below ground level. This information may be compared with field conditions outside the shelter belt of trees. There are marked variations in temperature and humidity which can be related to specific studies of fauna habitat situations and the effects that micro and macro climatology has on animal behaviour patterns within the shelter belt of trees.

These early pilot studies and additional future studies can perhaps help to build up a pattern of ecological detail specifically related to narrow shelter belts of trees so that comparisons can be made with other habitats such as hedgerows and woodlands, about which more is known.

The author will be pleased to provide a list of the references on which he has based these notes and which are suggested as suitable for further reading. His address is Government Buildings, Christchurch Road, Winchester, Hants.

Plastic Structures

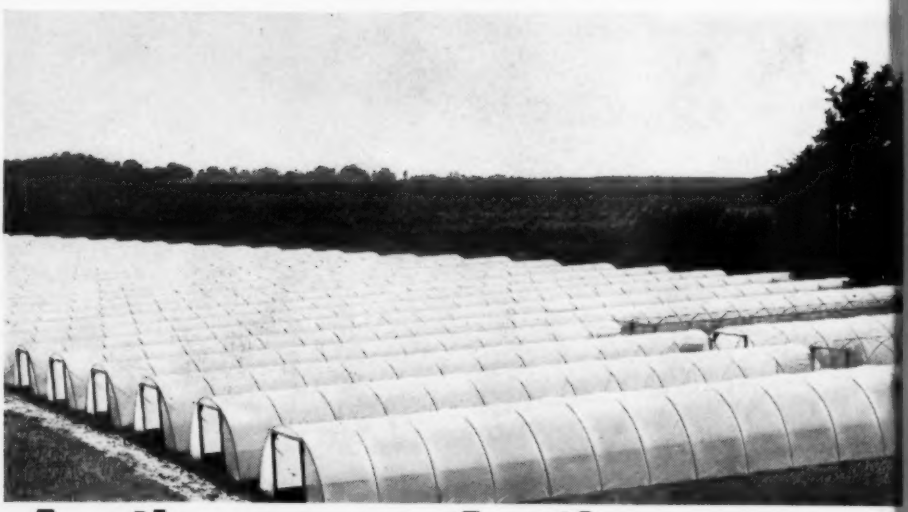
Prototype end-ventilated polyethylene tunnels of 20ft span at Lee Valley E.H.S.

This feature section contains articles by:

★ **P. G. Allen**, N.D.H.(Hons.), and **P. Allington**, B.Sc., respectively the Director and Deputy Director of the Lee Valley Experimental Horticulture Station.

★ **A. E. Canham**, M.Sc. (Eng.), C. Eng., M.I.E.E., who is in charge of the Applied Research Section of Reading University Department of Horticulture, Shinfield.

Cover photograph shows 14ft span polyethylene tunnels at Lee Valley E.H.S. growing unheated lettuce and self-blanching celery.



Another season. Another reason.

The time to do something about 'Visqueen' polythene-clad tunnel greenhouses – is now.

Then you can look forward to an extended growing season.

As well as earlier markets, greater productivity and consistent high quality.

They're all reasons enough in themselves. Especially when you consider that this new type of greenhouse is the simplest way of increasing your area of protected crops – and your profits – for the lowest cost.

But if you want another reason, think about European competition.

One grower in Spain, for instance, has over four times the total tunnel-covered acreage of this country – which, in turn, is a fraction of the greenhouse acreage in France and Italy.

Tunnel structures and fans now qualify for H.I.S. grants. So that helps keep capital outlay to a minimum. A 14' wide tunnel can be erected for less than 5p per sq. ft. of ground covered – without allowing for the grant.

But complete the coupon and British Visqueen will tell you all you need to know; about the performance of their ultra-violet inhibited polythene sheeting; about their new white sheet for the propagation and winter protection of plants in the hardy nursery stock industry; about the different types of structure available, with the names, addresses and literature of the manufacturers who supply them in kit form.

And British Visqueen should know. Not just because they're Britain's leading manufacturer of polythene sheeting for horticulture. But because they're the pioneers in polythene, responsible for more technical innovation and development than any other company. 'Visqueen' UVI, for instance, was used in all the original trials at the Lee Valley E.H.S.

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I'm interested. Please send me full details about walk-in-tunnels.

Name .....

Address .....

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'VISQUEEN' UVI

Long life sheeting in 125 mu (500 g.) & 150 mu (600 g.)

(021)

Plastic or Glass– This may be decided by Lee Valley EHS experiments into the design and use of

Film Plastic Structures for Horticultural Crops

P. Allington **P. G. Allen**

THE first polyethylene clad structures built in England followed traditional glasshouse design and took no account of the unique properties of the material. Building and re-cladding was complicated and time consuming, so many pioneers into plastics gave up.

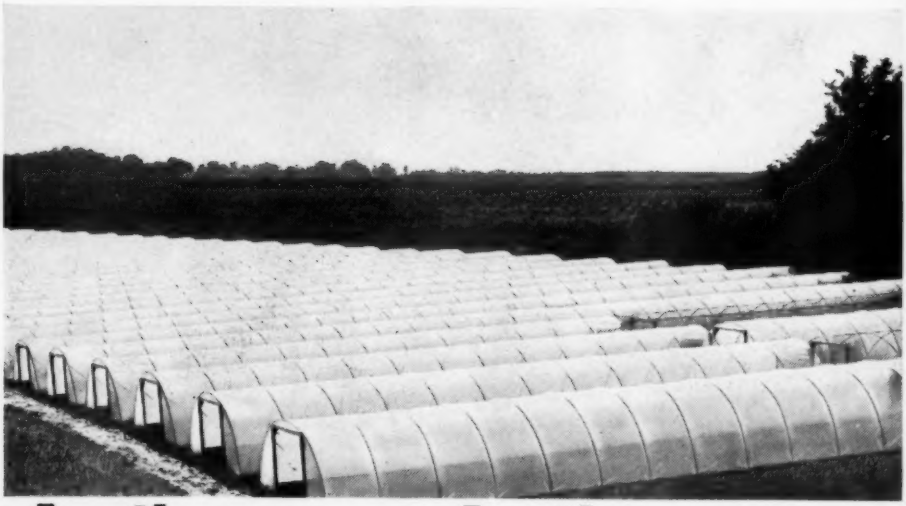
Rigid plastics have not replaced glass in traditional greenhouses because they are either too expensive, as acrylic sheet, or too short-lived, as uninhibited polyvinyl chloride (PVC). However there has been recent interest in ultra-violet inhibited formulations of rigid corrugated PVC for which manufacturers guarantee adequate clarity for at least seven years at prices approaching that of glass-cladding.

Bubble houses

Air-inflated film plastic bubble houses were introduced into Britain several years ago and attracted attention following developments at the National Vegetable Research Station and Reading University, where a design has been developed with rigid ends. Although cheap to erect, with ventilation possible by variable speed fan, commercial application has not been extensive, mainly because electrical standby equipment is needed and instability is reported with heavy wind and snow loadings. Good results have been obtained with strawberries and lettuce and temporary protection of watercress to obtain better quality in winter. For tomatoes and cucumbers there is no economic advantage over structures with a framework which also supports the crops. Bubble houses, seemingly, are of most interest for ground crops.

Polyethylene tunnels

The low, two to three feet wide polyethylene tunnels experimented upon at Fernhurst Research Station and Efford E.H.S. have been devoted almost entirely to strawberries, but they have also proved suitable for lettuce and early protection of runner bean crops and for propagating vegetables. Air temperatures are slightly lower than in glass cloches, and their large scale use is linked with the ability to erect them quickly by mechanical means and the advantages of lower capital and labour costs.



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In 1968 several centres in Britain began investigating the use of wider low tunnels and 'walk-in' structures with a rigid framework. The main work is centred at the Lee Valley Experimental Horticulture Station which is concentrating on the design of, and cropping in, such structures.

Film plastic tunnels of 14ft, 16½ft and 20ft span forming part of the unit at Lee Valley E.H.S.

Materials and designs

For structures to be attractive commercially their construction must be simple, functional, economically viable and cheaper than glasshouses. Design must allow quick and easy film replacement at frequent intervals due to U.V. degradation. The supporting framework should be smooth and curved to avoid tearing the plastic and strong enough to withstand gales and crop loadings. The edges of the plastic sheet should be secured evenly, either by burying in trenches or by sandwiching securely between two layers of wood or other material. The structures developed at Lee Valley are tunnel-shaped, using a galvanized steel tubular frame which is strong and smooth, yet can be bent and fixed easily by unskilled labour.

For the 'walk-in' structures 125—150 micron U.V. inhibited clear polyethylene film has been mainly used. In Britain it is available in widths of up to 36 feet; this has restricted the width of single span houses to a maximum of 22 ft. It degrades in 12–24 months, according to the formulation of the sheet, becoming brittle where exposed to sunlight and in contact with a hot frame; hence, it should be protected by masking or replaced at intervals. PVC is reputed to have a longer life than polyethylene but is not yet available in Britain in wide sheets. Those being tested have been made by welding together several narrow sheets.

Other materials attracting interest are EVA (Ethylene vinyl acetate) film and woven polypropylene. EVA has a high transmission of light and similar heat losses to PVC. Woven polypropylene is porous and this may assist ventilation. These materials and PVC are more expensive than polyethylene but they are reputed to have a longer life.

Light transmission

In the tunnels of Lee Valley design light transmission has been good, reaching 78 per cent during summer and averaging 60 per cent in winter,

resulting in quick establishment of plants and balanced growth. Transmissions of 81 per cent have been recorded in bubble houses without opaque framework.

Condensation

As with glasshouses, the inside of plastic cladding is usually covered by a layer of condensation which, subject to adequate air changes, need not materially affect relative humidity. This condensation forms droplets which are more apparent than the film of condensation on glass.

Wide plastic sheets are impervious to air and it is very easy for high humidities to occur due to insufficient ventilation; hence, plastic clad structures must be positively ventilated, particularly with disease-susceptible crops. In still, cool conditions the layer of condensation persists, even with fan ventilation and pipe heating, and improves the heat-retentive characteristics of the polyethylene without reducing the measured radiation below that of good quality glasshouses. In dry, warmer weather the condensation dries off, improving light transmission and reducing ventilation load.

Heating

Polyethylene film is relatively transparent to long-wave radiation; thus, radiant heat losses are high and air temperatures in unheated structures during radiation frosts can be as low as outdoors. Radiant heat losses, however, are reasonable in view of the condensation on the cladding and, in comparison with glasshouses, there are few air changes. Experience at Lee Valley indicates that the heating requirements of a film plastic house are similar to a glasshouse with the same surface area.

Prototype fan-ventilated tunnels of 22ft span

Ventilation

The transparency of polyethylene to far red radiation results in cooler air than in a similarly ventilated glasshouse. Air temperatures in tunnels 14 ft wide, 65 ft long, with 33 sq. ft opening at each end, were never more than 2·5°C above ambient in hot weather. In 22 ft wide tunnels with a crop at full leaf cover, fans have held the temperature to within 0·5°C of an ambient 30·5°C. Low tunnels with insufficient end ventilation for hot weather can

have additional ventilation provided by burning or cutting holes in the polyethylene.

Aerial environment

Film plastic structures could have a number of uses related to design and cost. Successful exploitation depends upon a full understanding of their aerial environment, which can be very different from that in a glasshouse. Not enough is known at present and to obtain more information a number of crops are being grown in each type of structure at Lee Valley.

Film plastic structures on test

The main potential in Britain is likely to be walk-in structures for propagation or to cover crops throughout their life. With the exception of the 33 ft span house, all structures at Lee Valley are station prototypes.*

Low tunnels

These 6½ ft tunnels erected at a total cost of 22p per square yard can be used like narrow low tunnels, but their greater height and span could mean wider uses.

The low cost, coupled with using 65 micron non-UV-inhibited film which can be discarded after each crop, makes them suitable for temporary protection and they should be considered only for this purpose. A suitable rotation would be to protect spring lettuce until April, then runner beans, followed in October by August-sown lettuce. When a crop is covered for a short period in autumn or in spring, ventilation is less important; this allows the erection of long tunnels ventilated by raising the ends, sides or burning a small number of holes in the plastic.

Single span tunnels (14-20 ft)

These structures can be completely constructed by growers for about 36-75p per sq. yard, inclusive of labour, using a framework of medium grade galvanized tube. They have a potential as unheated coverage or with inexpensive heating to give a small temperature lift in cold weather; they can be ventilated by the ends and if this is insufficient for long 14 ft span tunnels the plastic sheet can also be perforated at intervals along the sides. In 1969/71 at Lee Valley they were found particularly suitable for unheated crops of lettuce, self-blanching celery, sweet pepper, carrot, early-flowering chrysanthemum, column stock, antirrhinum, and for propagating celery and bedding plants.

Diseases have not been a problem on these crops, but in May 1969 ghost spot (Botrytis) was initially troublesome on unheated tomatoes because of insufficient ventilation. It was not appreciated then that more ventilation is required to provide an aerial environment similar to an unheated glasshouse; if this is done good quality tomatoes can be produced.

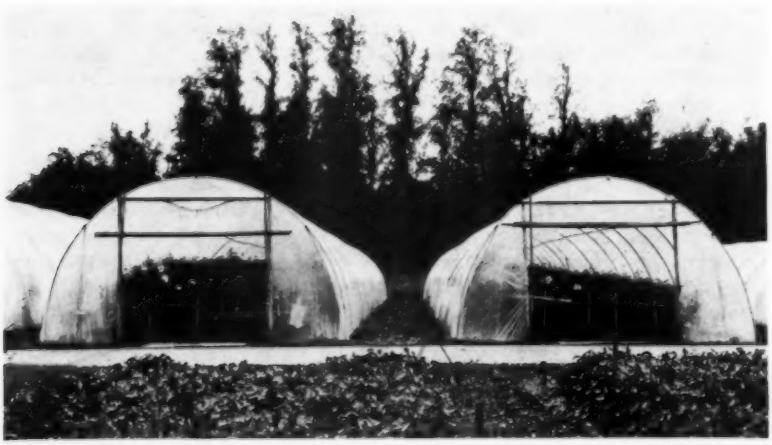
For optimum annual use, several crops should be grown in each tunnel and investigations show that a suitable rotation would be spring lettuce followed by sweet peppers, tomatoes, cucumbers or early flowering chrysan-

*Full details of the various prototype plastic tunnels are given in Leaflets 17 and 20, obtainable free from the Lee Valley EHS.

themums. If the summer crops are terminated in early September they can be followed by lettuce raised in containers. Supermarkets can sell lettuce grown under protection throughout the year and particular attention at Lee Valley has been given to using unheated tunnels for continuity production from April to early November. Preliminary results indicate that they will be suitable for some five crops of butterhead or four crops of crisp lettuce during this period if plants are propagated in containers. The main problems are suitable varieties and cultural techniques to give solid lettuce of adequate weight under warm summer conditions.

Recordings made at Lee Valley in January indicate that the minimum air temperature inside unheated tunnels during radiation frosts can be up to 1·5°C lower than in the open. The Fernhurst Research Station has protected a frost-susceptible crop against night air temperature of –4°C by applying water over the tunnel. A layer of ice up to ½ in. thick formed on the outside without causing any damage.

During April and May 1970 temperatures were compared in similarly constructed and managed unheated structures clad with 150 micron PVC and EVA sheets and 125 micron polyethylene which is relatively more transparent to far red radiation. Minimum night air temperatures recorded on clear radiation nights and maximum day temperatures on sunny days were up to 2·2°C cooler under polyethylene; this demonstrates the superior frost protection of PVC and EVA film, and the need for less daytime ventilation under polyethylene.



16½ ft span tunnels clad with PVC and EVA film, growing autumn chrysanthemums

Medium span tunnels (22 ft)

It was originally considered at Lee Valley that the main use of film plastics would be for structures complementary to glasshouses and to extend the season and improve the quality of crops normally grown in the open. Development of this type of tunnel, with a framework of 1 in. galvanized tube and costing 135p per square yard (including fan ventilation) has indicated that it could replace glasshouses for unheated crops and might be used for heated production throughout the year, especially in view of the good

Prototype fan-ventilated polyethylene clad triple-span house 120ft × 65ft at Lee Valley E.H.S. Note slender infra-structure giving good light transmission

light transmission. During 1969/70 high quality crops of antirrhinums, column stocks and October chrysanthemums were grown in unheated tunnels and very promising results are being obtained with carnations, winter chrysanthemums, cucumbers, tomatoes and sweet peppers in similar tunnels heated with steam pipes. 'Damping-off' of the flowers of carnations has not been experienced during humid low light conditions of winter; perhaps this was attributable to operating the fans for a few minutes at regular intervals to purge the atmosphere and replace very humid air. This procedure, if followed on cool bright days, would prevent carbon dioxide depletion when normal ventilation to control temperature does not occur. These results confirm observations made on commercial holdings and indicate the possible use of the structures for propagation and the production of vegetables and flowers.

Large span structures (33 ft)

This Danish steel structure with ridge ventilation was clad originally with 200 micron polyethylene which had a useful life of almost two years. At present the house is used from March to September for cucumber production, and winter flowering chrysanthemums with the aid of steam heating; good quality, high yielding crops have been obtained. In comparison with a similar age cucumber crop in an air-heated glasshouse, there have been more 'cold marking' blemishes on one variety due, perhaps, to low skin temperature of the fruits or to high humidity from insufficient ventilation in the early stages after planting. In 1969 a high yielding crop of unheated tomatoes was grown, but fruit blemish from Botrytis spot was a problem at certain periods and indicated that ridge ventilation without side ventilators provided insufficient air changes for a house of this span. Fan ventilation would simplify construction and provide more positive air movement.

Insulated tunnel clad with black plastic

A prototype tunnel 72 ft by 22 ft erected on a concrete base at an inclusive cost of 275p per square yard (450p including environmental control unit) is also under test for the production of mushrooms. The 'U' value of around 0·2 gives a low heat requirement and ensures that it keeps cool in warm weather. Very satisfactory crops of mushrooms of up to 3·5lb per square foot have been obtained from five inches of pressed compost in six weeks. When cooking out, a temperature of 88°C in the compost has been obtained on seven occasions, including one when the outside air was at 0°C, without any apparent damage to the galvanized steel tube framework or the polyethylene cladding. This tunnel could be used for various purposes, and if adapted as a low cost linear 'growing' room the technique could be used extensively with mechanized handling of plants.

Multispan tunnels

Prototypes with two and three spans of around 20 ft and total widths of 53 and 65 ft respectively were erected in 1971 at a cost of approximately 190p per square yard, including fan ventilation, to examine their performance for a range of crops. These houses could be very suitable for mechanized lettuce production and, in view of the good light transmission, high quality heated crops could be obtained during the winter and early spring. In the autumn of 1971 the double span house has been used for a very successful crop of cucumbers and in 1972 the above multispan structures will accommodate early main crop tomatoes and cucumbers.

The Jones-Bateman Cup for Research in Fruit-Growing

The Jones-Bateman Cup, presented in 1920 by Miss L. Jones-Bateman of Cae Glas, Abergele for the encouragement of fruit production, is offered for award triennially for original research in fruit culture which has added to our knowledge cultivation, genetics, or other relative matters. The Cup is offered by the Royal Horticultural Society for award in 1972.

Candidates should submit accounts of their work, which should have been mainly carried out in the United Kingdom and mostly during the last five years, to the Secretary, The Royal Horticultural Society, Vincent Square, Westminster, S.W.1, by 31st October, 1972. There will be three assessors (two appointed by The Royal Horticultural Society and one by the National Farmers' Union), who will report to the Council of the Society upon the originality and comparative potential value to the fruit-growing industry of the work of the candidates.

The Cup will be held for three years by the successful candidate, who must give a bond for its safe return. The holder will be able to compete again on the next or any succeeding occasion. When the Cup is relinquished the holder will receive a Hogg Medal.

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FARMELECTRIC

(004/005)

Fig. 1 Two bubble houses on a Berkshire nursery, used mainly for growing strawberries

The Air-Supported Greenhouse

A. E. Canham

Now that it has at last been accepted that plastics film greenhouses have a useful part to play in the horticulture of this country—thanks largely to the work at the Lee Valley Experimental Horticulture Station—a grower who wishes to invest in this form of protection can choose from a range of different frame designs according to his needs. The purpose of the frame is to support the plastics film envelope above the crop in the most convenient shape combining satisfactory headroom and maximum light transmission, at the lowest possible cost.

The characteristics of plastics films are such that they lend themselves admirably to an alternative means of support giving maximum light transmission, namely air pressure. The concept of air-supported structures is by no means new. A patent was taken out in 1911 for 'the construction of tents for field hospitals, depots, and like purposes'; 'air houses', as they are sometimes called, have been used to protect radar equipment, to store industrial and agricultural products, and for recreational activities, exhibitions, etc. The principle was first applied to greenhouses in this country in 1954 when a patent application, subsequently allowed to lapse, was applied for under the title 'Inflatable Greenhouses'.

The need for maximum light transmission and minimum cost impose

greater restraints on the design of greenhouses than on industrial structures but designs have been evolved which have proved satisfactory for growing a wide range of crops. A number have been erected for experimental purposes at various research stations* as well as on a number of commercial holdings (Fig. 1).

Construction

The basic components of a 'bubble house,' as they are colloquially called, are the envelope, one or more fans for support and ventilation, means of anchorage and access, and an outlet for ventilation air.

Envelope. This must be chosen from a limited range of transparent films of suitable size and with appropriate physical characteristics; these will determine the size of the house. So far, 500g polyethylene film containing an ultra-violet radiation inhibitor has been the most widely used. It is available in a single sheet 131 ft (40m) long and 36 ft (10·9m) wide from which a structure about 120 ft × 29 ft (36·6 × 8·8m) can be constructed. The width is dictated by the strength of the film, the maximum support pressure, the method of anchorage and the acceptable profile of the house. The method of anchorage determines the width of film left for the envelope and the distance between the 'walls' then determines the profile and the working height. If maximum coverage is required the profile is relatively flat and working height limited, especially at the sides. At the other extreme, the structure will be tall and unstable in windy conditions. Between these two extremes is the semi-circular profile, the ideal for maximum light transmission. Profiles rather flatter than the semi-circle appear to offer a satisfactory compromise, but as the stresses in the envelope are proportional to the radius of curvature (for a given pressure), this radius must not be increased too much. The characteristics of the film suggest that a width of 24–26 ft is about the maximum which can be achieved with 500g. polyethylene and a reasonable factor of safety. The latter should be relatively high (= 3, for example) in view of the difficulty of predicting the stresses likely to result from violent gusts of wind and to allow for some weakening with age.

To achieve greater widths, it is necessary to use thicker materials, but as these are available only in widths less than 36 ft, this can be done only by joining sheets; for maximum strength, joins should be circumferential rather than longitudinal. To date, experience with these larger structures is relatively limited. Larger areas can indeed be covered by enabling the stresses to be borne by an arrangement of nets or wires outside the envelope, such as has been used for covering a football pitch and on a one-acre greenhouse in America. This however adds materially to the cost of what is basically a cheap structure.

Fans. One or more fans must provide support for the envelope under normal conditions, an increased pressure for improved stability under storm conditions, and adequate ventilation to limit the temperature rise inside in the summer. Propeller fans combine the advantages of a high throughput at a suitable pressure for ventilation with the ability to provide an adequate stabilizing pressure when running almost stalled.

*The National Vegetable Research Station, the Scottish Horticultural Research Institute, the University of Nottingham School of Agriculture, and the Applied Research Section of Reading University Department of Horticulture at Shinfield.

A very low pressure is adequate to support the envelope under still air conditions but very light breezes can cause deformation. In practice a pressure of 0·2–0·3 in. water gauge (w.g.) has been found adequate for a wide range of weather conditions but this should be increased to about 0·5 in. w.g. when strong winds and storms are expected. Even greater stability can be achieved with still higher pressures but at the risk of incurring excessive stresses in the envelope.

In addition to the ability to develop a pressure of 0·5 in. w.g. the fan system must be capable of providing adequate ventilation. What is meant by 'adequate' is debatable; current recommendations for ventilating plastics film greenhouses call for a ventilation rate of 5–7 ft^3 of air per minute for every square foot of covered area to achieve satisfactory cooling during the summer. Our own experience with ventilation rates as low as $2ft^3\ ft^{-2}\ min^{-1}$ suggest that this recommended rate could perhaps be reduced, especially if the emphasis is on spring and early summer crops.

Early designs employed a relatively small fan—12 in. diameter—to provide merely support pressure and a second, larger, fan to provide ventilation. In the structures at Shinfield we have used a single fan—24 in. diameter, 940 r.p.m.—for all purposes. This is run at a reduced voltage (ca. 180 volts) for support purposes but full mains voltage is applied under the control of a thermostat when ventilation is required. Similarly, when extra pressure is required for storm conditions, mains voltage is supplied by means of a manual switch, although some form of automatic control is possible. This fan is capable of providing 5,500 c.f.m. of ventilating air; for larger structures it may be better to use a number of fans, arranged to be switched on in succession to reduce the running costs. A 'butterfly' flap, to minimize back flow of air should the fan stop for any reason, is a useful precaution. An essential feature is that the fan housing should not be directly fitted to the envelope; this restricts movement and can result in excessive stresses in the film. One solution is to interpose a flexible duct, made from polyethylene film; another is to introduce the air under the edge using some form of rigid ducting.

Anchorage. An important feature of the bubble greenhouse is the method of fixing the film to the ground. A firm anchorage is necessary to counteract the upward force exerted by the support pressure which under some wind conditions may be augmented by aerodynamic lift.

The original procedure was to bury the edges in a trench. This had the merit of simplicity but involved either the use of a mechanical trenching machine for speed or extensive manual operations. It also reduced the amount of film available for the structure. Various alternatives have been tried and the method currently in use at Shinfield employs an 8in. × 1in. wooden batten on edge, about half buried in the ground and bolted to 2in. square wooden posts, 3 ft 6 in. long, driven into the ground every five feet or so. The film is fixed to this by the simple expedient of rolling the edge round a 2 in. × ½ in. wooden batten which is first nailed and then screwed to the ground batten (Fig. 2). This has enabled the width of the house to be increased to 29 ft using 36 ft wide film. Air leakage below the buried edge of the batten can be reduced by adding a polyethylene skirt stapled to the batten and buried still deeper.

Access. Although it is possible to fit a single light door into the skin of a bubble house it cannot be used for any length of time without loss of pressure

Fig. 2 A method of anchoring the film to the ground with battens

and the structure becoming 'floppy'. A more satisfactory procedure is to use a double door arrangement to provide an air-lock. As with the fans, this should not be fixed direct to the envelope but connected by a flexible duct to allow unimpeded movement of the house. So far these door arrangements have only been large enough for the entry of personnel, although it is possible for them to be made large enough to accommodate tractors.

Ventilation outlet. To minimize the number of appendages needing connections to the envelope it is convenient to mount the ventilation outlet above the door. This takes the form of a weighted flap, hinged at the top, which remains closed when ventilation is not needed but will open wide when it is. The position and weight of the counterbalance is carefully chosen to achieve this, and its operation is assisted by the use of side baffles to ensure that the maximum lifting force is applied to the lower edge of the flap (Fig. 3). When extra pressure is required to provide additional rigidity under storm conditions, a restraint in the form of a bar or a hook and chain is applied to prevent the flap opening further than is necessary and to allow the pressure to be developed.

Rigid ends

An alternative to the true 'bubble' is a structure with rigid ends made up from 2 in. × 2 in. timber and covered with a separate piece of polyethylene. This makes the construction less simple but offers a number of advantages. It enables the full length of the polyethylene sheet to be used to cover the maximum possible length of structure, and provides a convenient framework on which to fix ventilators, fans and doorways. It also allows a ducted-air heater to be used, as the chimney can pass through such an end without difficulty; our limited experience to date suggests that it may be better able to withstand storm conditions than the fully flexible structure. Fig. 4 illustrates the main features of the construction.

Emergency precautions

The bubble house depends completely on a continuous supply of electricity, but even the most reliable supply networks can sometimes fail. For this reason a fully-automatic stand-by generating plant is the best form of safety precaution, but unless one is already available on the nursery its provision could add considerably to the cost. At Shinfield, battery-driven stand-by fans have been used quite successfully—on one occasion supporting the structures for a total of 16 hours after a local fuse had blown—but they cannot provide enough pressure to withstand storm-force winds. The house at Mylnefield was allowed to collapse completely whenever the supply failed—once during a gale—but was re-erected each time without damage to the lettuces growing in it. Taut nylon cords stretched from end to end of the rigid-framed structures have been used to help keep the polyethylene sheet clear of crops but this might not be adequate in a gale.

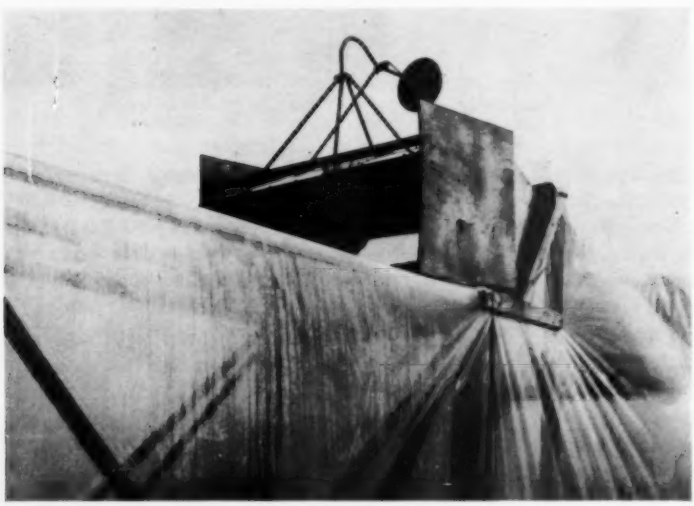

Fig. 3 Counterbalanced ventilator with side shields

Economics

It is difficult to provide a reliable estimate of cost for an air-supported structure as most of those used so far have been virtually 'do-it-yourself' systems using a high component of nursery labour.

It is estimated that those most recently erected at Shinfield with rigid ends and providing a covered area of 114ft × 26ft (2964 sq. ft) cost about £300 in 1971 for the materials and equipment. This includes end frames made up to a given design by a local firm of joiners at £70 per pair (as charged for three pairs) and the ventilation thermostat, but excludes wiring to the site and the control switchgear. A further £40 for labour costs of erection brings the total to £340, or 11·5p per sq. ft. This compares with a figure of £480 (14·5p per sq. ft) for a 150 ft × 22 ft framed tunnel complete with fan ventilation, which, unlike the bubble house, is eligible for an H.I.S. grant. By sacrificing a little headroom near the sides the width of the bubble house could be stretched to

29ft, an increase of just over 11 per cent in the area covered, for virtually no extra cost. It could also have been increased in length to about 120 ft.

There is of course an annual charge both for replacing the plastics film—which should be a biennial event costing about £23 per annum if the new extended-life film lives up to its maker's claims—and for electricity. The average electricity consumption for each of three bubble houses during the year ending 31st August last was 5,300 kWh. At 0·9p per kWh this is an annual charge of about £50, or 1·7p ft^{-2} respectively for the houses costed above.

Fig. 4 A rigid-ended bubble house at Shinfield

Environment

There is no basic reason why the environment in a bubble house should be very different from that of a rigid-framed plastics film house fitted with similar fan ventilation. The light transmission is very good—an average of 70 per cent has been recorded over a period of time with spot readings in excess of 80 per cent—and the structure is remarkably 'moisture-tight'.

Owing to the relatively cold envelope and the surface characteristics of polyethylene film, condensation occurs readily and forms in large droplets during the winter. It can be reduced by early ventilation and has so far not proved a serious problem. It does, in fact, help to reduce the transparency of polyethylene film to long-wave radiation and so to conserve heat within the structure.

As with all fan-ventilated structures a regular temperature gradient is produced, the magnitude of which depends on the ventilation rate, and results in some unevenness of cropping. Growth can be depressed near the fan inlet unless some form of baffle is used to break up the main air stream.

Crops

A wide range of crops has been grown in houses erected around the country but their main use has been for lettuce and strawberries. Other successful crops have included peppers, cucumbers, aubergines (at Mylnefield), tomatoes, potatoes, runner beans, French beans, sweet corn (at Wellesbourne), rice (at Sutton Bonington) and celery, green beans, bulb

flowers and radishes (at Shinfield). We have also used them very successfully for experimental crops of soya beans and cow peas, as the addition of a little heat has provided an environment not too far removed from that of the low-altitude humid tropics!

Grower experience

In addition to the structures erected experimentally at research stations, a number of growers have found them very satisfactory, especially for strawberries, lettuce and peppers. One grower in Berkshire has used up to ten at one time, and is currently experimenting with a structure with rigid sides and ends covering an area 100 ft × 175 ft in a multi-bay type of construction. At the beginning of December last he was using five simple bubble houses each 300 ft long and one 200 ft long and is proposing to erect another in the spring covering an area 300ft × 42ft to give a total area covered by air-supported structures approaching 1½ acres.

Another grower has used one no less than 450 ft in length—but only 16 ft wide—for strawberries, whilst over watercress beds in Hampshire a number are in regular use held down with a plastics net. Others have been used successfully by growers in Wales, Devon and Surrey. They are, however, unlikely to be adopted on a large scale so long as the framed walk-in tunnel enjoys the advantage of the H.I.S. grant, but it should be remembered that the polyethylene film itself is not eligible for grant.

Nevertheless, they clearly have advantages of cheapness and flexibility to offer the grower who is looking for temporary protection, and may well have a place for year-round use on a limited number of nurseries.

Warble Fly

Act now to prevent infestation this summer

Farmers who did not treat their cattle against warbles last autumn may now be fattening the grubs of the pest which could infest their herds this summer.

There is still time to treat the animals with systemic warble dressings to kill the grubs before they emerge. The dressings should be applied in March or April. They are simply poured or brushed on to the backs of cattle which were grazed last year, taking care to follow the manufacturers' instructions. Alternatively, a derris preparation may be applied, but this has to be scrubbed into warble holes.

The cost of dressing is amply repaid in the improved condition of the animals, more flesh, less injury to teats and udders, and less damage to hides and meat.

Care should be taken to store systemic dressings safely away from children and animals. Empty or used containers, if not returnable, should be disposed of so as to prevent possible contact with children and animals and to avoid possible contamination of water supplies.

Land transactions recorded by the former Northern Pennines R.D.B. show the trends in

Farm Structure in the Northern Pennines

P. D. Chamberlain

THE powers vested in the former Northern Pennines Rural Development Board provided a unique opportunity to study the pattern of land transfer and to measure its effect on farm structure. Under these powers all sales of agricultural land in the private sector, but not including devolution on death and transfers to close relatives, were subject to a system of consent, and information about the structure of the holdings affected by a proposed transfer was submitted to the Board by the vendor after the purchaser had been selected. The Board's area consisted of 3,000 square miles of upland and hill land containing an estimated 6,300 agricultural holdings.

In the first full year of operation (1st November 1969-31st October 1970) 46 per cent of the land transferred was sold as self-contained units and 28 per cent of the land sold was amalgamated with land already held by the purchaser. Land being taken out of agricultural use for afforestation accounted for 24 per cent but this included two sales of over two thousand acres so that it would be dangerous to regard this percentage as typical. The applications for the year are summarized in Table I, which classifies them in acreage groups and gives the average acreage of each category. The notification procedure did not set a lower limit on the area for which consent was required and one-third of the applications concerned relatively small areas, generally attached to private dwellings. It will be seen from the table that for every self-contained unit changing hands there were over three transactions involving an amalgamation.

The total area for which application was made in the year was 29,950 acres representing 2.35 per cent of the estimated area of agricultural land in the Board's area, excluding common land and woodland. Regional differences in the rate of exchange are shown at Table II, which excludes the domestic category. The low figure for Northumberland is interesting and is thought to be partly a reflection of the larger average size of holding in the county, or, more likely, due to a larger proportion of tenanted holdings.

Table I

Summary of land transfer applications—year ending 31st October 1970

Category and acreage group		*Applications*		*Acreage*		*Average*
		No.	*Percentage*	*No.*	*Percentage*	*acreage*
For retention as separate units:						
Exceeding 300 acres	9					
100-300 acres	16					
50-100 acres	17					
25-50 acres	7					
Less than 25 acres	7	56	14	13,618	46	243
For ultimate afforestation:						
Exceeding 300 acres	2					
100-300 acres	7					
50-100 acres	—					
Less than 50 acres	3	12	3	7,190	24	599
Resulting in amalgamations:						
Exceeding 100 acres	23					
50-100 acres	30					
25-50 acres	29					
Less than 25 acres	104	186	47	8,490	28	45
Land held primarily for domestic purposes		140	36	652	2	5
		394		29,950		

Table II

Regional differences in rate of land transfer within R.D.B. area—year ending 31st October 1970

County	*Estimated acreage of agricultural land in R.D.B. area, excluding commons and woodland*	*Acreage of land for which application made**	*Percentage*
Northumberland	406,000	3,240	0·8
Durham	97,800	3,222	3·3
Cumberland	161,900	6,730	4·2
Westmorland	178,100	3,490	1·9
Yorks. North Riding	190,600	6,536	3·4
Yorks. West Riding	239,600	6,080	2·6
Lancashire	4,120	—	—
	1,278,120	29,298	2·3

*excludes transfer of land held primarily for domestic purposes

An analysis of 100 applications where the land was being retained in agricultural use showed that the transactions were:

Sales to sitting tenants	11
Sale and lease-back arrangements	3
Sales subject to tenancy but with a view to expansion when the land came in hand	2
Sales with vacant possession	84

Taking the last group, the most vital from the farm structure standpoint, the ways in which land was being released and taken up were examined. The results are shown in Table III. These illustrate that, as might be expected, it is the occupier giving up farming who is the most frequent source of land coming on to the market. In many instances the decision to sell was accompanied by more than one transaction, for example where a holding was sold in lots, and in the sample 36 occupiers gave up farming. The reasons given were:

Retirement	20
Death	3
Ill-health or accident	4
Surrender of tenancy	1
Other reasons, including taking up another occupation	8

The 'reducing acreage' group also included several occupiers who were going into semi-retirement or reducing commitments because of illness, but the most common reason for selling in this group was an estate management decision, usually involving an exchange of land or the sale of an off-lying parcel.

Table III
Ways in which land was released and taken up in sales with vacant possession

		Outgoer			*Total*
		Giving up farming	*Moving to another holding*	*Reducing acreage*	
Incomer	Entering farming	3	2	3	8
	Moving from another holding	6	1	1	8
	Enlarging acreage	39	9	20	68
Total		48	12	24	84

The effect of the 84 vacant possession sales was to eliminate 27 holdings and to create four, a net reduction of 23 holdings. Three of the four holdings created were, however, only small units of under six acres. An examination of the purchaser's business in 60 of the 68 amalgamations, where this information was available, showed that there were:

42 commercial holdings (providing full-time occupation for at least two men)
13 intermediate sized holdings (providing full-time occupation for at least one man)
5 part-time holdings (not providing full-time occupation for one man).

Thus it tended to be the larger holdings which took up the available land and of the 18 non-commercial holdings to which land was added only three thereby attained commercial status. Looking again at the 68 cases where the land was to be amalgamated it was found that in 41 instances (60 per cent) the

purchaser held adjoining land so that the extra land was integrated with the existing holding. In the other 27 cases (40 per cent) the added land was separate from that already held, but in all except 5 of these the parent holding was within three miles. The majority of cases in the sample were located in the Yorkshire Dales where fragmentation is a common problem.

The results of the sample indicate that in one year sales of land would eliminate between 60 and 70 holdings, or 1 per cent of the holdings in the Board's area, and that 5 per cent of the holdings would undergo a structural change. This, of course, relates only to the owner-occupied holdings and a similar, if not more pronounced, trend would be expected among rented holdings held in estates. The Northern Pennines is an area with two thirds of the holdings not of commercial size and a half of these not even providing full time occupation for one man. Clearly a general improvement in farm structure, however much it is needed, is a long-term process. In order to judge the extent of the Board's contribution to it one would need to see statistics over a longer period; but from the indications above the trends are in the right direction.

P. D. Chamberlain, B.Sc. (Est. Man.) A.R.I.C.S., who was seconded to the Northern Pennines R.D.B., is now serving with the Lands Arm of A.D.A.S. at Skipton.

Carrot Production and Marketing

A report on the economics of carrot production and marketing in Britain has been published by the Agricultural Economics Unit of Cambridge University.* The report brings together the results of a survey undertaken jointly by the Universities of Cambridge, Leeds, Manchester and Nottingham, and co-ordinated by Cambridge University.

The report is based on a survey of the crops of about 100 growers throughout the country in 1968-69 and describes the pattern of production and the markets supplied. It describes the part played by carrot merchants in both production and marketing and shows that profit per acre is in proportion to the investment in the crop. Profit is highest for the farmer who grows and markets for himself and lowest for the farmer who rents his land to a merchant.

With changes in both supply and demand, carrots have fluctuating prices and profits per acre. The report suggests that the carrot grower accepts this situation because carrots are an important break crop for cereals and their value to him exceeds their recorded financial return.

The report includes imputed costs and returns for the 1970-71 crop. It ends with a summary of the trade in carrots in the European Economic Community and concludes that in Britain carrot production is more highly organized, and the crop is produced more cheaply than in any country in Europe except Holland. Both production and consumption of carrots in Britain are increasing, and there may be scope for some further expansion of production, particularly of the luxury, finger-type carrots.

**The Economics of Carrot Production and Marketing in Britain—A Commodity Study*, by W. L. Hinton, can be obtained from the Agricultural Economics Unit, Department of Land Economy, University of Cambridge, Silver Street, Cambridge, CB3 9EL, price 50p.

New herbicides approved under the Agricultural Chemicals Approval Scheme have prompted advances in

Weed Control in Vegetables

J. W. Hancock

THE control of weeds in vegetable crops has long been a costly undertaking and when machinery and hand labour only were available it was a limiting factor to the acreage a grower could manage. The introduction and rapid increase in the use of herbicides has been a major factor in changing the pattern of vegetable production towards larger units. This has been complementary to the requirements of the processing industry and to modern fresh vegetable marketing. Five years ago there were only some fifteen chemicals and few mixtures suitable for use on vegetable crops. Now the number is about twice as many and new uses for established chemicals are arising each season. The development of the spacing drill, together with herbicide programmes, is making possible new concepts in vegetable production.

Mini caulis

Mini cauliflowers could not be grown without herbicides. The requirement is for a precision drilled crop at high density. Any of the herbicides tolerated by the cauliflower would leave some weeds unrestrained, but by using two herbicides with complementary weed spectrums a good weed control is obtained over a long season. The first is trifluralin, a highly volatile chemical which must be incorporated in the soil immediately after spraying. This is applied before planting and will control a range of weeds which includes fumitory, knotgrass and redshank. It will not, however, control groundsel, and this is accounted for by propachlor applied after the seed is sown but before germination. Propachlor will also give a second check for weeds which trifluralin would normally control.

Brassicas and legumes

The brassica grower now has a range of herbicides to suit his needs. Those which may be applied before planting are di-allate for wild oats and blackgrass or trifluralin. Before seeding, trifluralin may be used, and propachlor or aziprotryne as pre-emergence applications; or use may be made of selective contact action among young plants with desmetryne, aziprotryne or sodium monochloroacetate. The ultimate choice depends on the actual crop and weeds present or known to be present from the previous crop. In leguminous crops, weed control in peas is still based largely on dinoseb in various forms and on prometryne, but recently some newcomers are attracting interest.

Unsprayed weeds in runner bean crop

Aziprotryne is now formulated with simazine to improve persistence and widen its range. Optimum control is obtained with application at weed emergence to take advantage of both contact and residual action. A trietazine and simazine formulation has given good residual control of annual weeds and has a useful persistence. Cyanazine has residual and contact action and so can be used both pre- and post- emergence, a few weeds such as charlock being controlled by contact action up to 8in. high. Damage to the crop from contact herbicides depends largely on the amount of wax present and here the crystal violet test is widely used to check that the herbicides may be safely applied.

Runner beans have always been a difficult crop with which to obtain good weed control without crop damage and growers will welcome a new experimental herbicide PH 40–21. Both commercial and official trials have shown this to be a most promising chemical. It has shown crop safety together with a persistence which has lasted long enough to control the late germinating black nightshade.

Root crops

Carrots were one of the early crops for chemical weed control when tractor vapourizing oils spraying quickly made growers independent of much summer labour. The crop now has attracted a wide range of herbicides of

which chlorbromuron, both at pre-emergence and applied after the crop reaches the second true leaf stage, is a distinct recent advance. The new precision with which this crop is grown to provide correctly sized carrots for the canning trade is making heavy demands on herbicides for complete crop safety with a high level of weed control.

Red beet growers are fortunate that sugar beet is a major crop. Developments have all come by way of sugar beet. Good residual weed control is obtained from lenacil or from proprietary mixtures and the advantages of these are now extended by a contact herbicide phenmedipham which will control a wide range of annual weeds and can be applied at any stage after the cotyledon is expanded. Although this herbicide is normally safe, damage has occurred in very hot weather.

Onions

Recent work at the National Vegetable Research Station on weed competition in onions has shown that only during a critical period of 5½–7½ weeks after 50 per cent crop emergence does the presence of weeds effect yield. Nevertheless, if only for ease of harvesting, this is a crop requiring good weed control throughout. Residual pre-emergence treatments with propachlor, chlorpropham and its mixtures and a proprietary mixture of pyrazon and chlorbufam are now well established. Recent advances are with selective contact herbicides

Weed control with PH 40-21 in runner bean crop

aziprotryne, ioxynil and a mixture of ioxynil and linuron applied after the three leaf stage; although a temporary check may occur the plants rapidly recover and yield is not effected. As with peas, safety depends on leaf wax and this can be tested by the crystal violet test. The use of selective contact herbicide is particularly valuable as weed control does not depend on soil conditions as is the case with residual herbicides. Methazole is a potentially valuable herbicide which can be applied to onions at the two leaf stage and has great persistence. Its performance in trials has been good and there should be a place for it in the weed control programme.

Lettuce

Lettuce is a crop in which we still seek a satisfactory weed control. Chlorpropham has always had the disadvantage of not controlling groundsel and mayweeds and in this respect the new herbicide pronamide is little better. It is, however, less damaging to the lettuce and can be used on it at any stage. It is rather a persistent material and the maker's warnings about following crops should be observed.

Application problems

Developments are occurring with problems of application. Greater reliability may be obtained if some herbicides are soil incorporated. Trifluralin is already established in this respect and lenacil performance can be improved by this means. Investigation into other materials is proceeding but results should not be applied to all cases because there are difficulties. The chemical can be over-diluted by the soil and it may be effected by different soil type.

Granular herbicides have useful properties. Granular propachlor has been in use for the past season and has given better weed control than the spray, particularly in unfavourable dry soil conditions. Some other vegetable herbicides are likely to become available as granules, opening up great possibilities for the commercial grower. The main break to this development is a lack of good granual application machinery. Such a machine must be able to apply 10–60 lb of granules per acre evenly. It should be reliable, easy to set and clean and its price must compare favourably with that of a conventional sprayer.

Finally, chemical weed control in vegetables can now be almost complete for the grower who is prepared to look hard at the subject and to plan his cropping with a knowledge of weed distribution on his farm in order to give the greatest chance of success for his herbicide sprays.

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Conway Castle and the River Ogwen

6. Conway and Ogwen, Caernarvonshire

W. Roy Davies

THE district of Conway and Ogwen comprises the eastern part of Caernarvonshire, bordering on Denbighshire to the east; the River Ogwen marks the western boundary, whilst the Irish Sea forms the northern edge and the Snowdonia massif lies to the south.

A large part of the district is in the Snowdonia National Park, and its beautiful but rugged scenery is enjoyed by thousands of holidaymakers each year. The tourist industry is, in fact, extremely important and the region offers a wide choice of holiday for the urban dweller. Opportunities for hill walking, pony trekking and angling excel, whilst Llandudno, nestling between the two rocky headlands of the Great and Little Orme, offers facilities comparable to any other major seaside resort. The picturesque and walled town of Conway on the west bank of the river has remained generally within its original bounds and the history of the town is practically the history of the magnificent castle, built by Edward I.

Bethesda, a pleasant town at the foot of the Nant Ffrancon Valley, illustrates the importance of the slate quarrying industry of days gone by. Today, although small factories have replaced the quarries as a source of remuneration to the inhabitants, the scars still remain.

Geographical features

The area can be defined by three main physical regions. First, the Creuddyn Peninsula bounded by the sea, the Conway estuary to the west and the old course of the Conway. The peninsula of the Great Orme, which rises to nearly 700 feet, typifies the carboniferous limestone ridges of the area. The rest of the region has a very complicated soil pattern ranging from brown earths of a high base status to areas of pure sand.

The second region is the Conway Valley. The flat alluvial valley floor ranging from half to three-quarters of a mile wide rises steeply on the Caernarvonshire side, contrasting with the more gentle Denbighshire slopes on the opposite bank. The river is tidal as far as Trefriw, some ten miles from the mouth, and so flat is the valley bottom that Betws-y-Coed fourteen miles up river is only fifty feet above sea level. The soils of the valley display a complete range of drainage conditions. From Trefriw to Betws-y-Coed almost all the soils are freely drained; below Trefriw to Talycafn there is a peaty, wet area of low agricultural value. The western slopes and the narrow coastal strip between Bangor and Llanfairfechan again display a great variation in soil types, although the Denbigh series, which is a free draining silty loam, occupies a considerable proportion of it.

Finally, there is North Snowdonia, most of which is situated in the Conway and Ogwen district. The main mass is almost all above the 2,000 feet contour and numerous peaks rise steeply to well over 3,000 feet. Fast flowing rivers run down the many valleys between these ridges to feed the large number of lakes that can be found in the area.

The climate is temperate, influenced by the western seaboard. Rainfall variation is extreme, from 29–30 inches in Llandudno and the Creuddyn Peninsula to 60–70 inches only a few miles inland. The higher peaks of Snowdonia receive more than 150 inches per annum.

A considerable acreage is under forests, trees and woodlands. The Forestry Commission occupies 20,000 acres around Betws-y-Coed, of which 15,000 have now been planted. Known originally as the Gwydir Forest it has now been split in three, namely the Gwydir, Lledr and Machno Forests. Sitka and Norway spruce are the two most common species grown.

Farming systems

The topographical and climatic conditions dictate the type of farming practised and understandably the area is mainly devoted to livestock rearing. The district has approximately double the area of rough grazing compared with crops and grass, and 90 per cent of the latter is in fact under permanent pasture.

LIVESTOCK

On the harder farms, with a large area of rough grazing and very little improved or in-bye land, the main and very often the only enterprise is hill sheep. The Welsh Mountain ewe is very hardy and able to thrive under these difficult conditions. The flocks are self-contained and produce store lambs for fattening on lowland farms. After three or four lamb crops on the mountain the ewes are sold as 'drafts' to lowland farmers in the Lleyn Peninsula, Anglesey, and in some parts of England to be crossed with lowland rams for fat lamb production. Wool is another source of income from sheep, but is declining in importance as the competition from artificial

fibres increases. Ewe lambs and some of the younger ewes have to be wintered away on lowland farms at a considerable cost. Farm output is relatively low and, as there is no opportunity for fattening any of the progeny, prices in the autumn store stock sales greatly influence the income.

Farms with improved in-bye land are not so vulnerable to the store market situation. Some fattening can be achieved and normally a herd of single suckling Welsh Black cows add to the farm income. The cows, in the main, calve in March/April, the progeny being sold at the autumn sales as weanlings or as yearlings the following spring. Some farmers are turning to autumn calving in an attempt to produce a bigger, more saleable store for the autumn sales. However, the February or March born calf has certain advantages on this type of farm. First, winter housing and feeding, which is always a problem, need not be so costly. Also, with much of the summer grass coming from rough grazing areas, a cow with a calf at foot is well adapted to feed off this sparse herbage far better than a 6–12 month old store. Where there is a certain amount of better land available for the suckler enterprise during the summer then there may be a place for autumn calving.

Moving down to the lower slopes and the valleys, the grassland is grazed by ewe flocks producing fat lambs, suckling herds and fattening cattle and, of course, the dairy cow. Although certain farmers are moving to the bigger breeds for fat lamb production, the Welsh Mountain draft ewe is still by far the most common. Managed successfully, after crossing with either a Suffolk or Dorset Down ram, the profitability of this sheep enterprise can be very reasonable.

Beef production is practised on numerous farms in the Conway Valley. Strong store cattle bought either locally or from Ireland give a quick turnover of capital, but with today's high prices encountered in the spring, even the most skilled 'fattening farmer' has found margins very small.

Although dairying has been only briefly mentioned, it is nevertheless an extremely important enterprise. The average herd size, still below 20 cows, is increasing. Many of the progressive producers have adopted the new technological methods of production which can be found in any part of the country.

Pig herds are limited in the main to a few sows on a comparatively small number of farms and weaner production is the normal practise. Weaner groups, and there are three in the area, indicate the co-operative aptitude of the farmers as well as ensuring a known price for a good quality product.

ARABLE CROPS

Crop production is mainly supplementary to the livestock enterprises. Barley is the main cereal, but there are still several oat crops to be seen. Stooked corn is now a very rare sight, the combine harvester having taken away one of the countryside's most pleasant features! Other crops such as potatoes and horticultural produce are of very minor importance.

The farming community

This article would not be complete without mentioning the farming community. Like the Welsh Mountain ewe the hill farmer is acclimatized to the environment. He is friendly and sincere, and relies greatly on neighbourliness to complete many of the stock handling operations. The farming

systems are traditional, but technology is gradually changing and easing his farming methods. The majority of the people converse in Welsh and they are proud to maintain the historical and cultural values of previous generations.

Agriculture and tourism

As in all such areas there is an ever increasing difficulty in meeting the different requirements of the farmer, forester and tourist. Each, of course, must have an important part to play in the overall economy. The amenity and recreational value is unquestionable, and as the demands of tourism will undoubtedly continue to increase it is vital that the farmers and urban visitors get on well together. Recent developments such as the planning of Farm Trails and Forest Picnic Sites are indicative of a greater understanding of each other's needs.

Ministry Publications

Since the list published in the February 1972 issue of *Agriculture* (p. 87) the following publications have been issued.

MAJOR PUBLICATIONS

BULLETIN

Bull. 160 Housing the Pig (Revised) 55p (by post 60½p) (SBN 11 240460 X)

REPORTS

Agricultural Statistics 1968-69 United Kingdom (New) 74p (by post 78½p) (SBN 11 241017 0)

Agricultural Statistics 1969-70 England and Wales (New) £1·25 (by post £1·31) (SBN 11 241061 8)

DEPARTMENTAL PUBLICATION

Apple Register (New) £11·30 (by post £11·65) (overseas £12·50)
Available only from Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middx. HA5 2DT (not for resale (SBN 85521 017 6)

FREE ISSUES

ADVISORY LEAFLETS

A.L. 310. Fluke or Liver Rot in Sheep (Revised)
A.L. 449. Japanese Beetle (Revised)

SHORT TERM LEAFLETS

S.T.L. 15. Chemical Weed Control in Top Fruit Orchards (Revised)
S.T.L. 135. Vehicular Access Arrangements on Farms (New)
S.T.L. 136. Buildings for Onion Drying and Storage (New)

UNNUMBERED LEAFLETS

Food Hygiene on the Farm (New)
The Egg Trade and the E.E.C. (New)

Priced publications, unless otherwise stated, are obtainable from Government Bookshops (addresses on p. 142) or through any bookseller. Single copies of free issues are obtainable from the Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middlesex HA5 2DT.

in brief

- **The strategy of shopping**
- **Design for pigs**
- **A sticky end for aphids**

The strategy of shopping

SHOPPING and its likely development continues to be a talking point. Much of the discussion stems from the report*, published last year by the National Economic Development Office, which contends that the next ten years will be marked by considerable change and development in the shopping scene. By 1980 consumers' expenditure is estimated to increase to between £13,000 million and £14,500 million (at 1963 figures), as compared with £9,800 million in 1968. The proportion of this increased expenditure spent on food, drink and tobacco will diminish, while that spent on goods other than food will increase. This forecast emerges from the researches of the Shopping Capacity Sub-committee, which seeks to alert the distributive trade to the likely pattern of future shopkeeping and shopping practice; for it is here, at the end of the line, that production, whatever form it takes, comes to fruition or failure.

It was natural that the concept of shopping, which may be said to have first taken recognizable shape in the Middle Ages, should have developed steadily throughout the intervening centuries as trade expanded and population multiplied, but at no time has the speed of change been so great as that experienced since the Second World War. The inexorable advance of bigger and/or integrated retail outlets has put Goliaths in the High Street who are already seen to be outgrowing their town centre environment as the practice of shopping by car increases. Inevitably, the sequel has been a thinning of the ranks of the small shopkeepers, and the report indicates that by 1980 the number of shops in Britain will have dropped by about one-fifth to a total of 400,000, with multiples likely to gain at the expense of independent retailers having less than ten branches. We can expect the number of larger supermarkets, i.e., those with over 10,000 sq. ft of selling space, to increase to around 400 by 1980. They will account for nearly 10 per cent of total food sales and most of them will be run by about half a dozen major supermarket chains.

Already gathering pace under local government planning, traffic-free shopping precincts and covered walks are concentrating consumer expenditure in town centres, whilst in the suburbs the importance of parades of shops, which were an innovation in the 1930s, is seen to be declining—again under the pressure exerted and convenience offered by the supermarket. The development of massive out-of-town regional shopping centres is another deployment in the shopping strategy, although so far only a small number have been constructed in Britain. In contrast, in the U.S.A. a third of all retail sales are reported to be rung up in regional centres. A population of at least 100,000 to 250,000 is needed to support such a centre, and the minimum site area, with parking facilities for, say, 4,000 cars is about 40 acres.

Questionnaire probing to establish the future pattern specifically of food retailing reveals the likelihood that the share taken by grocery outlets (i.e., other than

*_The future pattern of shopping_. N.E.D.O. Obtainable from H.M. Stationery Office £1.25.

specialist food retailers such as butchers, fishmongers, etc.) will increase to 53 per cent by 1980, and the share of the total food trade by supermarkets and superettes* will double to 26 per cent in the same time. The growing emphasis on the presentation of all kinds of packaged and processed foods and the stimulating of consumer interest in a wider and wider range of convenience foods has a clear message for farmers and growers where, in particular, contract growing and vertical integration of production and supply bite more deeply into the tradition of laissez-faire farming.

In passing it may be wondered where the street market fits into the sophisticated strategy of shopping envisaged in 1980. That hundreds of street markets still survive after nine hundred years says much for their past resilience; an assumption that the lowly vendors will still be crying their wares at the end of the century may not be unwarranted.

Design for pigs

ALL but the younger generation will readily recall the days when domestic pigs were accommodated in dark, fetid sties, with rooting space confined to a morass of mud. The environmental conditions today are so far removed from this hovel-type husbandry that even the word 'sty' is acquiring an archaic definition; the modern word is 'housing'. The discovery that the pig is naturally a clean animal and that the old-time methods did more to foster and spread disease and so cause a high rate of mortality than to encourage a worthwhile return in the fattened sow and her litter survival has had its repercussions throughout the whole gamut of pig production.

The new edition of the Ministry's bulletin 160, *Housing the Pig*†, which has been revised strictly in the light of the official code of recommendations for pig welfare, provides abundant evidence of this, from discussion of outdoor and indoor types of housing and their construction, the attainment of optimum conditions of environment and ventilation to the emphasis on hygiene. As is pointed out, as much as two-thirds of the capital required for a pig enterprise nowadays is represented by the buildings, and thus their design, upon which production is so heavily dependent, is a fundamentally important factor. The variety of systems of pig keeping available today, with the bias weighted in favour of indoor housing, provides the farmer with such a wide choice as to fit every conceivable preference whether yarding, the Scandinavian-inspired stall housing, tethered and untethered, or the compromise of loose housing with stalls. The plentiful provision of plans included in this bulletin will be admitted at once to be a most welcome asset.

In face of a still current mortality of 20 per cent of piglets, usually soon after birth, the value of well-designed farrowing houses and equipment cannot be stressed too often or too strongly—a consideration which alone might reasonably be expected to make this publication essential to every pig farmer who sees a potential increase in his enterprise for the outlay of 55p.

A sticky end for aphids

NEWS comes from the Long Ashton Research Station of nature's way of trapping greenfly on certain species of potato which might be exploited to give growers much cleaner crops. R. W. Gibson, writing in the *Annals of Applied Biology* (68, p.113), reports recent work at the Station which, by the use of a scanning electron microscope, the glandular hairs on the leaves of the wild Solanum species *S. polyandrum*, *S. tarijense* and *S. berthaultii* were seen to exude a viscous secretion when touched by foraging greenfly. In contact with air this exudate first binds and then sticks the aphis to the leaf surface, where finally it dies.

*Defined as a self-service food shop of 2,000-4,000 sq. feet net floorspace.

†Obtainable from H.M. Stationery Office, price 55p. (60½p. by post).

Apart from the damage which aphids do directly, the greater threat to plant health comes from their transmission of a host of virus diseases. If, as Dr. Gibson suggests, it should prove possible to breed these glandular hairs into cultivated varieties of potatoes, the boon to growers would be incalculable. It appears that the young leaves and stems of the wild species are more active in their exudate reaction to 'trespassers', but since older plant material is better able to resist virus infections, the potential advantage of breeding in this natural defensive mechanism is not impaired.

AGRIC

Fatal Accidents on Farms in 1971

One hundred and eighteen people were killed on farms in England and Wales during 1971, compared with 105 in 1970. This figure includes 23 children under 15 years of age, compared with 24 in 1970.

Of the various causes of death, drowning and those involving the handling of animals increased most sharply in 1971, although overturning tractors remained the largest single cause of fatal accidents on farms. None of the tractors concerned in the overturning cases was fitted with an approved safety cab, which would almost certainly have saved the driver from death or serious injury. Reports were received of 28 incidents in 1971 involving overturning tractors fitted with safety cabs; no one was killed in any of these incidents.

An analysis of the fatal accidents which occurred during 1971 is shown below. The figures in brackets indicate the number of children under 15 years of age included in the totals.

Self-propelled machines	
Tractors—overturning sideways	22 (1)
overturning endways	6
run over by	5 (2)
other incidents	4
Other than tractors	5 (2)
Other field machines	
Powered-trailed or mounted, other component	6 (2)
Implements—trailed or mounted	1 (1)
Trailer	3 (1)
Stationary machinery	
Augers	1 (1)
Cleaners and graders	1
Processing plant	1
Circular saws	1
Electricity	
Hand tools	1
Mobile equipment	1
Transmission and control gear (wandering or temporary)	1
Falls	
From or on field machines	8
From portable ladders	1
In open areas	1
From ricks and stacks	2
Other falls	2
Drowning	
In liquid	7 (6)
In grain	4 (2)
Animals	
Bulls	4
Other cattle	3
Poisoning	
Scheduled chemicals	—
Other pesticides	1 (1)
Gases	1
Falling and swinging objects	
Bales	1
Doors and gates	1 (1)
Other objects	9 (2)
Other injuries and diseases	
Strains (handling sacks or bags)	1
Lightning or explosion	1
Gunshot	6 (1)
Burns and scalds	2
Tetanus	1
Farmer's Lung	2
Other	1

Books

Systems Analysis in Agricultural Management. J. B. DENT AND J. R. ANDERSON. John Wiley and Sons, 1971. £5·40.

Management—art or science? Both views command equally adamant support. In truth, good management today makes use of both. Statistical techniques can present various courses of action; the manager's judgment must dictate which course is followed.

Messrs. Dent and Anderson have secured the services of a number of experts in the field of systems analysis, both in Britain and elsewhere, who have contributed chapters ranging in subject from statistical methods and computer languages to their application to fodder conservation and farm machinery selection.

An intensive pig enterprise, for example, with up to six stages of production from in-pig sow to final fattening is examined in relation to investment planning. The level of feed costs and the returns for different weights and grades at a given time determines policy and thus the annual throughput of the fattening house and the requirements for farrowing and weaning. The impact of a number of operational policies on returns to capital invested in stock and buildings is investigated, with simulation models to express pig numbers, weights and grades, biological considerations and other variable factors and costs which must affect decisions.

Farm Management Advisers have used unsophisticated operations research techniques to solve individual farm problems for many years, but an attempt to deal with all possible variables on a farm scale would render such methods too expensive to apply. The book under review is thus concerned mainly with the examination of management systems or farming types. It is designed for research workers and graduates in applied sciences and its language requires more than an elementary knowledge of simulation techniques. For those involved, however, it is an excellent addition to their library, being well written and liberally spattered with tables, diagrams and references.

W.V.M.

Potential Crop Production. Edited by P. F. Wareing and J. P. Cooper. Heinemann Educational Books, 1971. £6.

Based on papers given at a symposium held in 1969 at the University College of Wales, this book examines the biological and environmental limitations to crop potential in Britain. It is of particular interest to agricultural specialists and students concerned with the many aspects of crop production who require an up-to-date appraisal of the means of adjusting plant development by breeding, husbandry and chemical control. Basic biological principles affecting crop productivity are examined in some depth followed by chapters on balanced crop systems and the means of deploying resources successfully within the environmental restrictions. The crops covered range from forest to horticultural species.

Several contributors emphasize the need to maximize leaf area early in the life of a crop in order to improve the income of solar radiation in early spring. The effects of crop canopy are explored together with the means of attaining better arrangement of crop leaves to increase the efficiency of photosynthesis in plants. Inter-effects of roots and shoots are also given prominence, thus presenting a valuable insight into the structure and activity of the productive system of crops.

Plant breeding in arable crops, forage grasses and legumes receive deserving attention with clear definitions given of breeders aims in improving the conversion of energy and nutrients by individual crops under specific management and environmental inputs. Another section covers the physiology and mechanism of the resistance of plants to diseases and pests and delves into the prospects for wider adoption of integrated biological and chemical control. A chapter on the chemical control of plant growth traces the means of discovery of useful pesticides in the past whilst heralding a new approach, involving physiologists and bio-chemists, to the launching of agricultural chemicals of tomorrow, particularly those concerned with modifying crop plant growth.

Apart from an inference of dismal prospects for agricultural machinery research in Britain the book offers a valuable guide on the current and some future research requirements in crop production. Throughout it emphasizes the need for an interdisciplinary approach to solving crop problems if only to disentangle the combined effects of various external, often adverse, factors in the field.

R.G.H.

The Production and Management of Sheep. DEREK H. GOODWIN. Hutchinson Educational, 1971. *£1·25.*

There are two types of books concerning sheep. One takes a somewhat philosophical and personal approach to sheep production and usually poses problems rather than solutions. The second is full of factual material set out in an orderly sequence ideal for those sitting examinations yet without becoming too involved in arguments. This book falls into the second category and is a practical guide at a price which could easily be afforded by students of agriculture.

The introductory chapters deal briefly with the meat trade, reproduction and the basic concepts of growth and development in sheep which are fundamentally more important for producers to know about than many diseases and pests. It is a paradox that farmers often become obsessed with the causes of death in a few sheep while neglecting the means of increasing production from the proportionately larger number that live. Traditional and modern systems of sheep farming, as well as the numerous breeds, are described but the peculiar economic and management problems that have resulted in the decline in the size of the national sheep flock could be highlighted for the benefit of those who may regard sheep farming as an ideal occupation.

Newcomers and old hands will benefit from a study of the sections on sheep handling, for far too many sheep still receive rough treatment in pens and fields.

Metrication is here to stay and it is not the author's fault that many of us have to think twice about sheep per hectare and grams per day. Whatever nomenclature is used let us hope that the new generation of shepherds—technicians trained at our educational institutions—will apply to advantage the basic principles received from books such as this.

G.L.W.

Farm Management Pocketbook. Fourth Edition, 1971. JOHN NIX. *50p (post free).*

All who regard farming as a business will welcome this new edition of 'John Nix'; so well established has the Farm Management Pocketbook become that it is usually referred to simply by the author's name. In the five years since the first edition was published it has become the standard farm management reference book and so great has been the demand that each of the previous editions have had to be reprinted.

Whilst the fourth edition is little more than a revision of the previous edition, the rapid changes which are taking place make continual revision essential for sound farm business planning. In the two years since the third edition was published there have been two annual price reviews and a 'mini' review. These have resulted in changes in guaranteed price levels as well as in methods of support, besides which there have been rapidly changing costs.

The author, and those who have assisted him, have updated a considerable volume of information. The gross margin data are supported by so much detail that it is a simple matter to adjust the figures for yield, price or cost to meet almost any farm situation. Not only are all the important farm crops described but field-scale vegetables are also included. The principal breeds of dairy cows are treated separately, as are the many systems of beef production, whilst the complications of the guaranteed price regulations can be readily understood. There is a wealth of information on labour costs and requirements, machinery, buildings, capital, taxation and many other topics, so it would be no exaggeration to describe the pocketbook as a farm management encyclopaedia.

The pocketbook may be obtained from Publications, School of Rural Economics and Related Studies, Wye College, Wye, Ashford, Kent. Specially reduced rates are given for copies supplied in bulk.

S.B.L.

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Agricultural Chemicals Approval Scheme

First List of Additions and Amendments to the 1972 List of Approved Products for Farmers and Growers.

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CHLORANIFORMETHAN

For control of powdery mildew in spring barley and outdoor roses.

Liquids

Milfaron—Bayer Agrochem

DIOXATHION

An organophosphorus insecticide for control of codling and summer tortrix moths and red spider mite on apples and pear and pear sucker.

Liquids

Delnav 47—Bugge's
Delnav —Duphar-Midox

METHOMYL

A systemic carbamate insecticide for control of aphids on hop.

Wettable Powders

Du Pont Lannate Methomyl Insecticide—Du Pont

PICLORAM with 2, 4-D

A herbicide for control of docks, creeping thistle, ragwort and other deep rooted weeds in grass areas of no feeding value and of no special botanical interest, e.g. around farm buildings, on new cuttings, banks and reservations.

Liquids

Atladox—Chipman

NEW USES OF APPROVED PRODUCTS

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DIMETHOATE

A granule formulation has been approved for control of cabbage root fly and early aphid attacks on brassica crops.

Granules

Rogor granules—Fisons

TRI-ALLATE

The granules (Avadex BW granular) are now approved for use pre-emergence in spring barley and spring wheat and post-emergence in winter barley and winter wheat for control of wild oats.

TCA

Hoechst NaTA (Hoechst) is now approved for control of couch grass in drilled and transplanted Brussels sprouts and cabbages.

NEW PRODUCTS CONTAINING APPROVED CHEMICALS

DICAMBA with DICHLORPROP and MCPA

A new mixture for control of many broad-leaved weeds, especially black bindweed, knotgrass, redshank, poppy, hempnettle and scentless mayweeds, post-emergence in cereals and grass.

Liquids

Mephetol Extra—Chafer

SIMAZINE

Wettable Powders

Simazine 50 (selective weed control)—Duphar-Midox

AMENDMENT

MEVINPHOS

The use of this product for control of caterpillars on brassicas was omitted in error from the Chemical Guide.

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